

# LINESCAN HYPERSPPECTRAL IMAGE SENSOR

Imec's line-scan image sensors offer unrivaled cost versus performance implementation of hyperspectral imaging technology. Our solution integrates hyperspectral filters monolithically on top of the sensor at wafer-level, providing high-level performance with significant reduction in size and cost. Our standard off-the-shelf line-scan imager product includes 100 spectral bands and is packaged in a ready-to-use format for easy integration into your final application.

## HYPERSPPECTRAL TECHNOLOGY FOR REAL-WORLD APPLICATIONS

Hyperspectral cameras, compared to traditional cameras, divide the light spectrum in many small wavelength bands. Therefore, a hyperspectral camera captures the spectral fingerprint of an object, a unique spectral signature providing very detailed information about its exact material constitution.

Hyperspectral imaging improves considerably the identification and classification of objects and is today recognized as a key enabling technology for next-generation industrial inspection, medical diagnosis and security applications.

## IMEC'S UNIQUE SPECTRAL TECHNOLOGY

Our current hyperspectral imagers are built on commercially available CMOS image sensor wafers, specifically designed for the machine vision market, namely the CMOSIS CMV2000.

## KEY SPECIFICATIONS

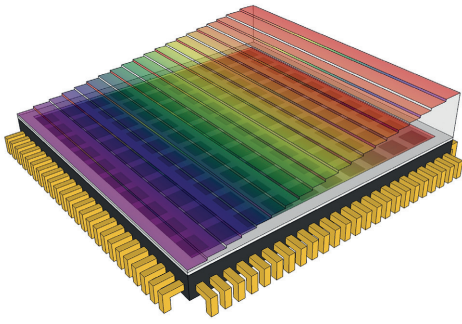
|                                    |                                       |
|------------------------------------|---------------------------------------|
| Wavelength range                   | 600-1000nm (NIR) or 470-900nm (VNIR)  |
| Number of spectral bands           | 100+ (NIR) or 150+ (VNIR)             |
| Bandwidth per band (FWHM)          | <10nm, collimated                     |
| Base imager type                   | CMOS imager, CMOSIS CMV2000 based     |
| Resolution                         | 2048x1088 pixels                      |
| Spatial pixels/lines               | 8 (NIR) or 6 (VNIR)                   |
| Spatial pixels/lines               | 2048                                  |
| Scanned hyperspectral lines/second | 2720 or limited by (camera) interface |
| Pixel pitch                        | 5.5µm                                 |
| Bit depth                          | 8 or 10 bit                           |

## KEY BENEFITS

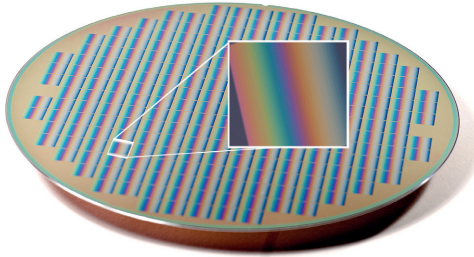
- **Extreme integration** of hyperspectral filters onto standard CMOS image sensors process: bulky collimator, prism and grating components are removed, no alignment issue
- **High performance & low cost** hyperspectral solution supported by CMOS processing base and manufacturing infrastructure
- **Customizable design** to match filter band selection with your final application requirements

## APPLICATIONS

- Optical sorting
- Spectroscopy
- Microscopy
- Counterfeit detection
- Skin health
- Agriculture
- Pharmaceutical
- Endoscopy
- Surveillance



Conceptual drawing of hyperspectral linescan imager with 100 static spectral filter structures



imec hyperspectral imager structures processed at wafer-level on top of commercial CMOS image sensor wafer

## SENSOR FEATURES & INTERFACE

- Pipeline global shutter with true CDS
- 340 frames/s in 8 bit mode
- 180 frames/s in 10 bit mode
- Row windowing capable of up to 8 separate ROIs
- X-Y mirroring function
- 16 LVDS-outputs @ 480Mhz multiplexable to 8, 4 and 2 at reduced frame rate
- Multiple high dynamic range modes up to 90dB
- On-chip temperature sensor & timing generation
- SPI control
- Ceramic 95 pin PGA package (18,6mm x 18,6mm)

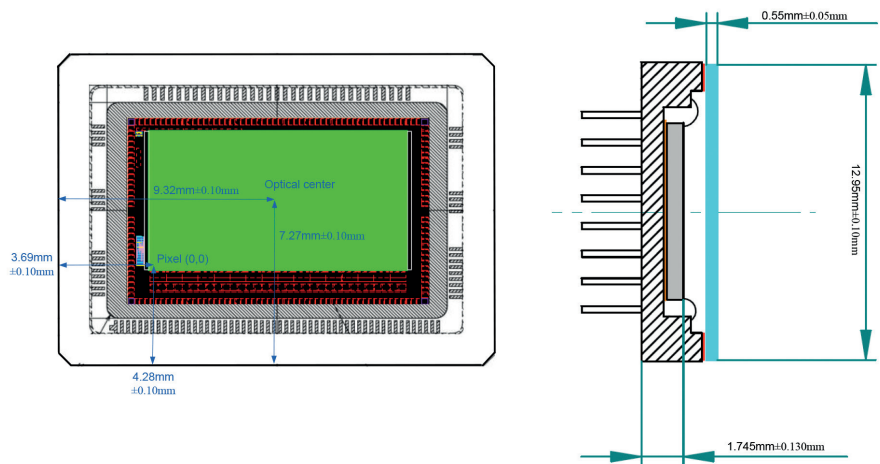
## CUSTOMIZED TO FINAL APPLICATION

The current 'off-the-shelf' imager product available from imec scans 100-150+ spectral bands in the 600-1000nm or 450-960nm wavelength region. Custom line-scan sensors can be provided based upon additional development.

This customization can be achieved by modifying the design of our filters over the CMOS sensor pixel array. Spectral filters can be tuned and designed for different numbers of bands, FWHM and different spectral ranges. By matching the spectral filters with the final application requirements, a custom hyperspectral imaging solution can be provided, optimized for size, cost and performance.

## BASE IMAGER PERFORMANCE

|                             |                              |
|-----------------------------|------------------------------|
| Resolution                  | 2048 x 1088                  |
| Pixel size                  | 5.5µm x 5.5µm                |
| Full well charge            | 13,5 Ke-                     |
| Conversion gain             | 0,075LSB/e- (10bit mode)     |
| Sensitivity                 | 4,64 V/lux.s                 |
| Temporal noise              | 13 e- (RMS)                  |
| Dynamic range               | 60dB                         |
| Optical format              | 2/3"                         |
| Parasitic light sensitivity | <1/50000                     |
| Dark current                | 125 LSB/s (@25°C)            |
| Operating temperature       | -30°C to +70°C               |
| Power consumption           | 600mW                        |
| Fixed pattern noise         | <1 LSB (<0,1% of full swing) |



Hyperspectral imager package pin-out configuration

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